In the Specification:

Please delete the paragraph starting on page 1 line 8.

Please replace the paragraph starting on page 2 line 21 with the following amended paragraph:

where $x_{h,k}$ is the intensity of the (h,k) pixel of reference window **32**, $y_{h,k}$ is the intensity of the (h,k) pixel of image **30**, and, for a real number a, the notation $\lfloor a \rfloor$ represents the largest integer that is less than or equal to a. (Note that the correlation function Corr is called "C" in the ~~Appendix~~ "Proof of Concept" section below.) With the indicated normalization, and given that all intensities $x_{k,l}$ and $y_{k,l}$ are non-negative, Corr(i,j) can take on values only in the interval [0,1].

Please replace the paragraph starting on page 3 line 19 with the following amended paragraph:

Recently, a new technology, whose most notable application to date has been in remote sensing, has matured. In this new technology, a scene is imaged in several spectral bands. Such imaging is known generally as "spectral imaging". If a small number (fifteen or fewer) of relatively broad spectral bands (for example, red, green and blue bands) are used, this technique is referred to as "multispectral imaging". If a large number of relatively narrow bands are used, this technique is referred to as "hyperspectral imaging". ~~Page 8 of~~ The first table (unnumbered) in the ~~Appendix~~ "Proof of Concept" section below lists a typical example of 19 adjacent spectral bands that span wavelengths from 435.3 nanometers (blue) to 891.1 nanometers (near IR). The "spectral images" acquired by spectral imaging are three dimensional arrays of intensity values, with each intensity value corresponding to the intensity of one scene pixel in one of the imaged bands. Figure 4 shows a spectral image **40** that consists of L IxJ spectral layers **42**. Three spectral layers **42** are shown explicitly. The presence of the remaining spectral layers **42** is indicated by ellipses (...). Each spectral layer **42** is a panchromatic image in its own right. Thus, spectral image **40** is a paralellopipedal array of pixels indexed by three indices i, j and l, with $i \in [1,I]$, $j \in [1,J]$ and $l \in [1,L]$. Each vertical column of spectral image **40**, *i.e.*, the set of pixel intensities indexed by a particular index pair (i,j) for all values of l in $[1,L]$, is referred to herein as a "pixel vector".

Please replace the paragraph starting on page 7 line 17 with the following amended paragraph:

FIG. 5 is a schematic depiction of an unmanned aircraft of the present invention[[.]];

Please insert the following nine new paragraphs after page 7 line 17:

FIGs. 6 and 7 show various projections of the hyper-correlation hyper-ellipsoid;

FIGs. 8 and 9 show histograms of 19-layer hyper-correlation after and before shifting the coordinate system origin to the center of the hyper-ellipsoid;

FIGs. 10 and 11 show the block structure of the normalized covariance matrix in areas with vs. without vegetation;

FIG. 12 is a reproduction of a table of sources and detectors of electromagnetic radiation in various spectral bands;

FIG. 13 is a graph corresponding to Table 7;

FIGs. 14 and 15 show various histograms of hyper-correlation vs. two-dimensional correlation;

FIG. 16 shows histograms of combined hyper-correlation;

FIG. 17 is a graph corresponding to Table 8;

FIGs. 18-22 are normalized covariance matrices for five different representative areas.

Please replace the paragraph starting on page 8 line 4 with the following amended paragraph:

As aircraft **120** flies above the battlefield, processor **124** uses spectral imager **122** to acquire spectral images **40** of the battlefield. Aircraft **120** transmits spectral images **40** acquired by imaging mechanism **122** to console **16**. Panchromatic images that are formed by stacking spectral images **40**, *i.e.*, by summing spectral images **40** along the wavelength axes thereof, are displayed on the video terminal of console **16**. When operator **14** sees a panchromatic image that includes summed pixel vectors corresponding to tank **10**, operator **14** designates those pixel vectors, using a conventional mechanism such as a mouse to pick the panchromatic image indices (i,j) that correspond to tank **10**. These indices are transmitted to aircraft **120** via

communication channel **18**. According to the present invention, a reference window, analogous to window **32**, is defined in the first spectral image **40** that contains pixel vectors corresponding to the target. This spectral image **40** is referred to herein alternatively as the "first" spectral image **40** and as the "reference" spectral image **40**. The reference window that is defined in the first spectral image **40** is an HxK rectangular array of pixel vectors centered on the pixel vectors corresponding to the target. Processor **124** hypercorrelates this reference window with the next spectral image **40** by constructing a hypercorrelation function Hyper(i,j). (Note that the hypercorrelation function Hyper is called "H" in the ~~Appendix~~ "Proof of Concept" section below.) The argument of this hypercorrelation function is a pair of pixel vector indices (i,j). For each pixel vector (i,j) in the next spectral image **40** for which the reference window can be centered on that pixel vector while still being contained within the next spectral image **40**, Hyper(i,j) is defined as:

Please replace the paragraph starting on page 9 line 10 with the following amended paragraph:

Hyper(i,j), as defined in equation (3), has been found to give results, when used with spectral images **40**, that are only marginally better than the results obtained using Corr(i,j) with panchromatic images **30**. As discussed in the ~~Appendix~~ "Proof of Concept" section below, the reason for this is that all the intensities $x_{i,j,l}$ are positive, so that all the pixel vectors $\vec{x}_{i,j}$ tend to be parallel. Therefore, instead of using raw pixel vectors in the right hand side of equation (3), shifted pixel vectors are used, to force the pixel vectors to point in disparate directions. The pixel vectors of the reference window are shifted by subtracting therefrom a common offset vector $\vec{x}_{off}$ and the pixel vectors of the next spectral image **40** are shifted by subtracting therefrom a common offset vector $\vec{y}_{off}$. One preferred common offset vector, that is subtracted from the pixel vectors of the reference window, is an average of all the pixel vectors of the reference spectral image **40**:

Please replace the paragraph starting on page 10 line 9 with the following amended paragraph:

Still better results are obtained by acquiring both panchromatic images **30** and spectral images **40** of the scene, and combining Corr(i,j) and Hyper(i,j) in a joint

correlation function Joint(i,j) that exploits both the sensitivity of Corr(i,j) to the intensities of the target pixels and the sensitivity of Hyper(i,j) to the spectral signature of the target. (Note that the joint correlation function Joint is called "JHC" in the ~~Appendix~~ "Proof of Concept" section below.) The preferred joint correlation function is a pixel-by-pixel minimum of Corr(i,j) and Hyper(i,j):

Please replace the paragraph starting on page 10 line 24 with the following amended paragraph:

Because of the limited weight and electrical power allowed to the on-board systems of an airborne platform such as drone **120**, and because of the high cost of hyperspectral sensors, it is preferable to use fewer spectral bands in the present invention than in conventional hyperspectral imaging. Although spectral layers **42** of a scene that are acquired in adjacent spectral bands are usually expected to be similar, it has been found empirically that for many terrains of interest, there is a relatively sharp break in the spectral character of the scenes at around 720 nanometers. Similar sharp breaks have been reported in the literature. See, for example, A. Kenton et al., "Joint spectral region buried land mine discrimination performance", *Proceedings of the SPIE on Detection and Remediation Technologies for Mines and Minelike Targets V*, vol. 4038 pp. 210-219 (April 2000). See also, for example, S. Kumar et al., "Best-bases feature extraction algorithms for classification of hyperspectral data", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 39 no. 7 pp. 1368-1379. The Kenton et al. paper is in a non-imaging context. Kumar et al. noted such breaks in an imaging context; but their focus was on *a postiori* decomposition of hyperspectral images into basis sets for landcover discrimination, and they apparently did not notice the utility of the breaks for the *a priori* merger of hyperspectral bands in data acquisition. As described in the ~~Appendix~~ "Proof of Concept" section below, another, less pronounced break in the spectral character of these scenes has been found at about 605 nanometers. Therefore, spectral images **40** of the present invention preferably include only two or three spectral bands. A preferred example of two spectral bands is a first wide band from 435 nanometers to 705 nanometers and a second wide band from 755 nanometers to 885 nanometers. A preferred example of three spectral bands is a first band from 430 nanometers to 605 nanometers, a second band from 605 nanometers to 720 nanometers and a third band from 720 nanometers to 975 nanometers.

Please delete the paragraph starting on page 11 line 18.

Please delete all of page 12.

Please replace the heading on page 13 with the following heading:

PROOF OF CONCEPT

Please replace the paragraph starting on page 18 line 1 (paragraph 0080 of the patent application as published) with the following amended paragraph:

Applying the hyper-correlation function, as defined in (2), we perform a combined spatial-spectral correlation by calculating the cosine of the ~~angel~~ angle between every spectral vector in the cube of interest and the corresponding spectral vectors in the checked sub-cube, and averaging the results. The values of this hyper-correlation function will thus range between 0 and 1, where the value 1 indicates an absolute match.

Please replace the paragraph starting on page 23 line 8 (paragraph 0100 of the patent application as published) with the following amended paragraph:

Its easy to see that this is the nature of the vector distribution in the spectral space, from the example below. We will present the hyper-ellipsoid by "projecting" it perpendicularly on some of the coordinate planes, there are L*[L-1]/2 planes of this type, and there we will obtain connections between pairs of spectral layers. We will choose four pairs, out of the 171 possibilities, as an example, all of which are firstly taken from the visible range (VIS). In Figure **[[A1]]**6, that shows projections of the hyper-ellipsoid onto four coordinate planes in the visible range, it's possible to see the elliptical shapes whose behavior is exactly as we have described.

Please replace the paragraph starting on page 23 line 15 (paragraph 0101 of the patent application as published) with the following amended paragraph:

The reason for this behaviour is the high correlation between adjacent layers that causes the ellipse to be narrow, and in the direction portrayed. See the Graph of Layer 2 versus Layer 4 in Figure **[[A1]]**6. Even when a pair of layers is at the two extremes of the visible range, the correlation will still be high enough to create an ellipse that has a large axis difference. See the Graph of Layer 2 versus Layer 14 in Figure **[[A1]]**6.

Please replace the paragraph starting on page 23 line 21 (paragraph 0102 of the patent application as published) with the following amended paragraph:

This is also correct for pairs of layers taken from the Near Infrared Range, (NIR), like the graphic connection between Layer 18 and Layer 19 in the

upper-left hyper-ellipsoid projection in Figure 7, and also between Layer 18 to Layer 16 in the lower-right hyper-ellipsoid projection in Figure **[[A2]]**7. But if the pairs are mixed, NIR and VIS, as in Layer 18 versus Layer 14 in the upper-right hyper-ellipsoid projection in Figure 7, and also Layer 18 versus Layer 10 in the lower-left hype-ellipsoid projection in Figure **[[A2]]**7, the elliptical shape is slightly blurred. This seemingly occurs because of the anti-correlative behavior of some of the picture components, probably because of the vegetation, about which we shall expand below.

Please replace the paragraph starting on page 26 line 8 (paragraph 0127 of the patent application as published) with the following amended paragraph:

The low sensitivity to changes in the acceptance threshold values shows that the hyper-correlation surface is less problematic, as can also be observed in the criterion of the surface maximum distance from the surface average, which stands at 2.5 units of standard deviation. This improved behavior can also be seen in the histogram of surface values shown in Figure **[[A3]]**8 that shows a histogram of normalized improved hypercorrelation results on the 19-layer cube. Analysing the histogram one may notice the existence of natural threshold points at 0.8, for example, which can be taken as an alternative to the existing threshold mechanisms, if needed for some reason. In comparison, the histogram of the surface before the improvement showed the accumulation of most surface points at values close to 1 and actually proved that there is no possibility for a robust automatic threshold mechanism for that same correlation function, as can be clearly observed in Figure **[[A4]]**9 that corresponds to Figure 8 before the improvement.

Please replace the paragraph starting on page 28 line 28 (paragraph 0139 of the patent application as published) with the following amended paragraph:

On top and inside the main "blocks" an additional "block" structure with less substantial differences may appear. These structures did not recur in the CM of the different areas whilst the basic structures recurred in every CM of every area that was checked. Figures **[[A5]]**10 and **[[A6]]**11 below are examples of the "block" structures. Figure 10 shows the “block” structure in an area with vegetation. Figure 11 shows the “block” structure in an area without vegetation.

Please replace the paragraph starting on page 29 line 19 (paragraph 0142 of the patent application as published) with the following amended paragraph:

Another explanation to the break line could be the changes in the physical source that causes absorption/reflectivity. In the Studies of Optics book by Hecht [2], page 77 and page 596, we learn that around the 700 nanometer area the physical source of photon absorption changes, from merely an external electron behaviour to a molecular vibration, also summarized in the Table on page 74 (see Figure **[[A7]]**12). If this is actually the reason, we must

still search for an explanation for the physical source of another recurring break line in the visible region in around 600 nanometers.

Please replace the paragraph starting on page 29 line 26 (paragraph 0143 of the patent application as published) with the following amended paragraph:

At the same time, this break line together with other break lines can maybe be explained as consequences of the vegetation, inasmuch as chlorophyll has a number of other weak and narrow absorption/emission lines, as for example, a maximal absorption at 443 nanometer and 665 nanometer and on the opposite a peak at 555 nanometer, and that is actually where we find some of the break lines between the blocks of the CM. But this explanation does not justify the continuity of the similarity in the consecutive channels which yields a wide "block", as can be seen in Figures **[[A5]]**10 and **[[A6]]**11.

Please replace the paragraph starting on page 35 line 11 (paragraph 0166 of the patent application as published) with the following amended paragraph:

The graphic description of the results is shown on Figure **[[A8]]**13. The curve for the improved two-dimensional correlation is (--+--+--). The curve for the improved hyper-correlation is (---------). And in conclusion:

Please replace the paragraph starting on page 37 line 1 (paragraph 0176 of the patent application as published) with the following amended paragraph:

Figure **[[A9]]**14 shows the two histograms of the Two-Dimensional Correlation (right) and Hyper-Correlation (left) surfaces for a type-I situation, that stresses the advantage of one method over the other. In Figure **[[A10]]**15 are shown the histograms (Two-Dimensional Correlation on right; Hyper-Correlation on left) for a type-2 situation, and they show a case of shared difficulty. Figure **[[A11]]**16 shows the histograms of the Combined Hyper-Correlation(s) for situations 1 (right) and 2 (left). It's easy to realize how much the results were improved, where the correlation values in the erred points were "pushed" to the left and received low values, creating a clear-cut division between the good and bad matches, meaning that the number of points that exceeded the threshold, for the various threshold points, became dramatically smaller.

Please replace the paragraph starting on page 37 line 11 (paragraph 0177 of the patent application as published) with the following amended paragraph:

This enlargement in performance, obtained through the Combined Hyper-correlation gives us a tool for performance improvement in area tracking, since it also handles field cells whose distinction is not sufficiently clear, as is shown in the histograms on Figures **[[A9]]**14 to **[[A11]]**16.

Please replace the paragraph starting on page 38 line 6 (paragraph 0180 of the patent application as published) with the following amended paragraph:

In Figure **[[A12]]**17 are shown graphs of the performance indicated on Table 8, that is, the average of performance level on thirteen objects for seven threshold values, for each of the three mechanisms. The curve for the two-dimensional correlation is (--+--+--). The curve for the hyper-correlation is (---------). The curve for the combined hyper-correlation is (o—o—o--). The graphic description clearly shows the improvement attained, and in particular, the improvement of Combined Hyper-correlation.

Please replace the paragraph starting on page 40 line 6 (paragraph 0186 of the patent application as published) with the following amended paragraph:

In addition, in order to have the possibility to define more accurately the boundaries of the "blocks", which are the wavelengths on which are the "break lines" in the succession of correlation values between the adjoining layers, data cubes of 48 spectral layers were taken. These layers were imaged in spectral bands of 10-12 nanometers wide, which covered, consecutively, the 430 to 990 nanometer range. That is, the Visible range and the. NIR range. Approximately twenty data cubes of 48.times.512.times.512 pixels were examined For each one of these, the normalized Covariance Matrix, which measures 48.times.48, was calculated, and presented through a gray scale matrix, in which the maximal value 1 was marked as white. The data cubes covered urban areas, rural areas, mixed areas, areas in which a major road covers a significant part of the image, and so on. Figures **[[A13]]**18 up to **[[A17]]**22 describe the results of five normalized Covariance Matrix CM in the five representative areas (field cell numbers 32, 52, 31, 82 and 61, respectively), which are different in character from each other. Despite the difference between them, it must be assumed that in each area, including urban areas, a vegetation exists although in various quantities. This fact is noted since it is assumed that the clear-cut dominant spectral behavior of the vegetation represents an important component in the structure of the normalized Covariance Matrix, as specified in the report.

Please replace the paragraph starting on page 40 line 40 (paragraph 0190 of the patent application as published) with the following amended paragraph:

In addition to these two "break lines", there are other, less noticeable lines, which demarcate "blocks" representing characteristic components of the specific field cell, and are not equally noticeable in the different matrixes, as is particularly noticeable in Figures **[[A13]]**18 and **[[A14]]**19.

Please insert the following paragraph after page 41 line 2:

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made.

Please delete pages 42-56.